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(54) Abstract Title
Telephone with multiple antenna configuration for reduced user irradiation

(57) A telephone handset 1 has an omnidirectional antenna 2 and a non-omnidirectional antenna 3, the latter being configured to minimize radiation into the human head when in use. A proximity switch 6 detects whether the phone is being held against the user's head or is in hands free mode and connects up the appropriate antenna, ie omnidirection for hands free use and non-omnidirectional for handheld use.

FIGURE 2

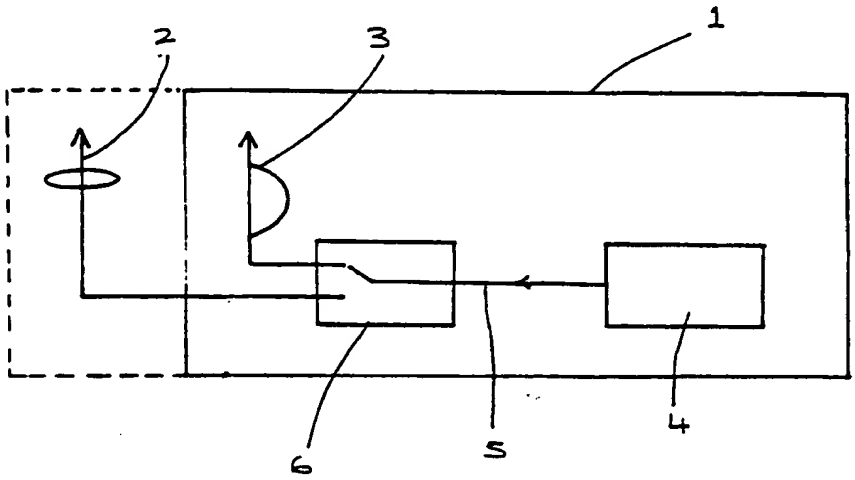

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FIGURE 1

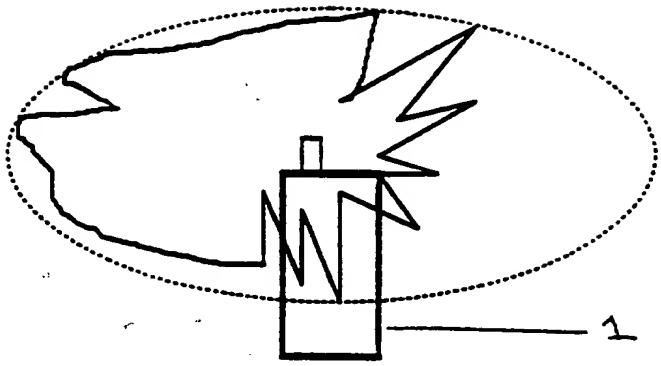
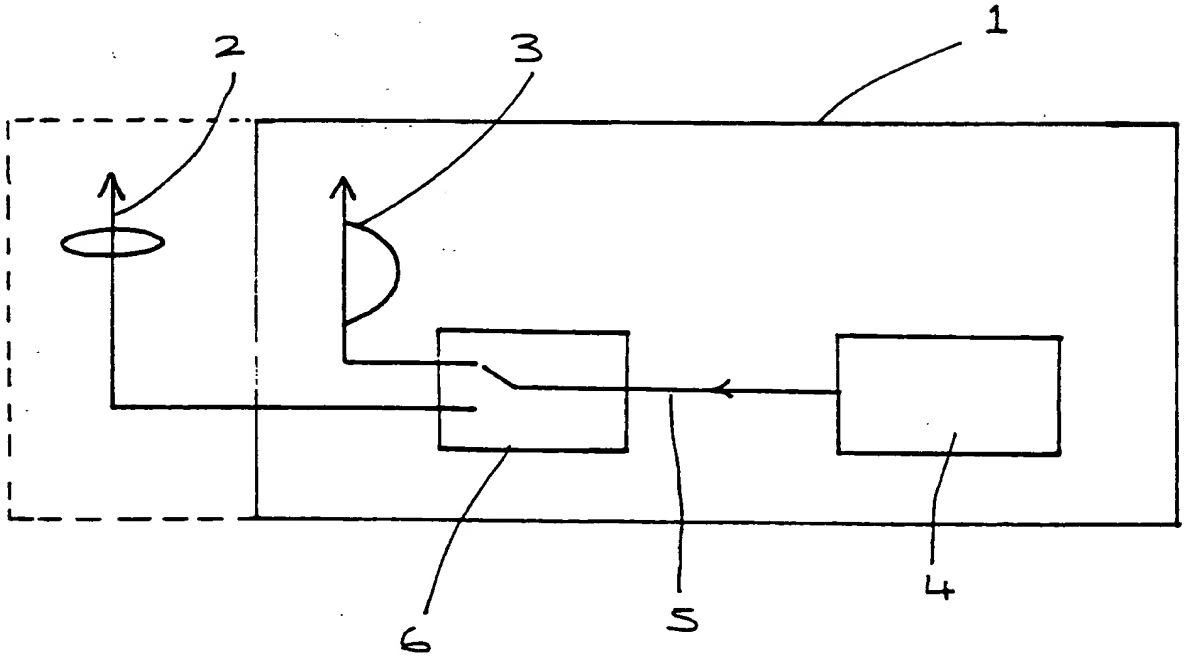


FIGURE 2



Telephone with multiple antenna configuration

Mobile Communication is expanding at a very rapid pace and the use of mobile telephone handsets for many forms of communication systems such as cellular, cordless and satellite is gaining great public acceptance.

The performance of the antenna of a mobile telephone handset has great impact on the quality of the RF link and the battery life. The greater the gain of an antenna in a given direction the better the signal to noise ratio will be at the receiver resulting in a more reliable RF link. This also means that a handset with a better gain antenna can be used at distances from the base station greater than the one with less antenna gain if all the other performance parameters are the same. In fringe areas where the signal levels are low, the handset with the greater gain will perform better in terms of maintaining the link.

Another important parameter that is being investigated more carefully in recent years is the effect of the electromagnetic waves radiated from a mobile handset when it is used in very close proximity to the human head. An omnidirectional antenna used right next to the head will have a great portion of its power absorbed into the head. This is an undesirable situation for two reasons: firstly, the ideal requirement is that no power should be wasted in the antenna or in any object in its close proximity. If much power is absorbed by the head then there will be less power for radiating which will result in reduced communication range. It is quite common that when a hand held is positioned next to the head its gain can be reduced by as much as 10 dB in certain directions which could easily more than halve the range that could otherwise have been possible to achieve. Secondly, the effect of electromagnetic radiation from mobile hand terminals on human health is a subject which is still being investigated very carefully. Therefore the less the power radiated into the human body the better.

The property of omnidirectionality for antennas is an important requirement for a mobile handset as neither the user nor the handset has any knowledge of the direction of the base station with which the mobile handset is required to communicate. Whatever the orientation of the handset it will receive identical power levels from the base station in all directions and conversely the base station will receive identical power levels from the mobile handset irrespective of its orientation. This requirement will easily be met by the use of an omnidirectional antenna in the handset when the handset is free standing. However, the same handset will lose this omnidirectional property when it is placed next to the head. The head and the hand holding the handset will absorb much of the power transmitted from the antenna distorting the radiation pattern of the antenna significantly as shown in Figure 1.

Since any power radiated into the head will be significantly absorbed by the head it would be advantageous to use during hand held operation an antenna with a radiation pattern which minimises the radiation from the antenna in the direction of the head. By concentrating power in the direction away from the head it then becomes possible to increase the gain of the antenna in that direction. Therefore the power is radiated more effectively in the direction away from the head rather than being wasted in the head.

The present invention provides a telephone having two or more antennae, each for receiving and/or transmitting electromagnetic signals, and switch means for selecting the antenna or antennae appropriate to the telephone operating conditions.

Preferably the telephone includes at least one non-omnidirectional antenna. The switch means may then be operable to select an antenna or antennae combination to provide non-omnidirectional transmission and reception. Thus, a telephone according to the invention is able to operate in "non-omnidirectional" mode during hand held operation and omnidirectional mode during hands free operation.

A micro strip patch antenna, with its characteristic D-shape radiation pattern may be employed as a non-omnidirectional antenna. A telephone according to the invention may also include an omnidirectional antenna or alternatively, omnidirectionality may be provided by an array of non-omnidirectional antennae.

The switch means may be manually operable. For example, a telephone according to the invention may have a manual switch for selecting the appropriate antenna or antennae. As another example, the selection of the appropriate antenna or antennae could be carried out in response to the operator pressing a key or other manual switch on the telephone to initiate or receive a call. Instead of being manually operable, the switch means may include a proximity sensor for detecting the proximity of a human head. The appropraite antenna(e) would then be selected according to a signal from the proximity switch.

Alternatively, a telephone according to the invention may be equipped with means for detecting when it is transmitting voice messages (as opposed to its regular update messages), with the switch means being responsive to the detection means. Thus, non-omnidirectional coverage could be switched in when voice messages were being transmitted. Of course, this might not be suitable for a handset designed to transmit voice messages in "hands-free" operation.

The expression "non-omnidirectional antenna" is intended to encompass any antenna with a null in its radiation pattern.

To summarise the foregoing, the use of antennas with a null in their radiation pattern can be utilised constructively for the dual purpose of minimising radiation into the head and also for maximising radiation in other directions.

While being converted into a constructive use for talk position, the loss of omnidirectionality is not desirable when the handset is freestanding. The requirement for the handset antenna when it is in freestanding position is as omnidirectional as possible. This requirement can be achieved by having a range

of switchable antennae. An antenna or a antenna combination with non-omnidirectional characteristics would be used when the handset is in talk position and the antenna or a combination of antennae with omnidirectional characteristics would be used when the handset is freestanding. Switching between the antennas can be realised by means of a proximity switch capable of sensing when the handset is placed next to the head. The switch would switch the omnidirectional antenna into use when the handset is moved away from the head.

An embodiment of the invention will now be described by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a diagram comparing handset antenna radiation patterns in free space and in talk positions; and

Figure 2 is a block diagram of a switchable antenna arrangement suitable for use in a telephone handset according to the invention.

Figure 1 has been briefly described above. The dotted line indicates the omnidirectional radiation typical when a telephone 1 is in free space and the solid line indicates the distorted radiation pattern which occurs when the telephone is held next to the head.

Figure 2 shows the telephone handset 1 having an omnidirectional antenna 2 and a directional or non-omnidirectional antenna 3. The omnidirectional antenna may be an extendable antenna on the outside of the handset housing or, as indicated by the dotted lines, an internal antenna within the housing. Also within the housing of the handset 1, as well as the usual electronic circuitry, is a proximity sensor 4 which sends a control signal along line 5 to a switch 6. The operation of sensor 4 and switch 6 is such that when an adjacent object (e.g. a head) is detected by the sensor. the antenna 3 is operational and when no adjacent object is detected by sensor 4 the antenna 2 is operational.

The sensor 4 effectively generates a control signal which indicates whether the handset is next to the head or free-standing. This control signal is used to select the suitable antenna by means of the switch 6; the omnidirectional

antenna for free-standing position and the directional antenna for talk position. The switch 6 is a low loss RF switch.

The omnidirectional antenna can be any of the standard omnidirectional antennae in common use. Retractable whip antennas and fixed helical antennas are two of the most commonly used antennae.

The directional antenna can be designed as a micro strip patch antenna. These antennas are also commercially available in small sizes suitable for use in small mobile handsets. As they have a D-shape radiation pattern the antenna gain can be greater than that achievable from a standard dipole antenna.

The micro strip patch antennas can be quite small to fit inside a handset. It is also feasible to combine two or three of these antennas to generate an omnidirectional pattern. The advantage of such a configuration would be increased gain over a dipole antenna and small size.

It will be appreciated from the foregoing that non-omnidirectional antennae, either singly or in combination, can be used to minimize the SAR (Specific Absorption Rate) in the body and also to maximize the antenna efficiency, whilst omnidirectional coverage using one omnidirectional antenna or a combination of non-omnidirectional antennae in freestanding operation can maximize the radio coverage of the handset so that it has equal ability to communication with any of the surrounding base stations irrespective of its orientation.

CLAIMS

1. A telephone having two or more antennae, each for receiving and/or transmitting electromagnetic signals, and switch means for selecting the antenna or antennae appropriate to the telephone operating conditions.

2. A telephone as claimed in claim 1 including at least one non-omnidirectional antenna.

3. A telephone as claimed in claim 1 or 2 in which the switch means is operable to select an antenna or antennae combination to provide non-omnidirectional transmission and reception.

4. A telephone as claimed in claim 1, 2 or 3 including at least one micro strip patch antenna as a non-omnidirectional antenna.

5. A telephone as claimed in any preceding claim including an omnidirectional antenna.

6. A telephone as claimed in any preceding claim in which the switch means is manually operable.

7. A telephone as claimed in any of claims 1 to 5 in which the switch means includes a proximity sensor for detecting the proximity of a human head.

8. A telephone substantially as hereinbefore described with reference to the accompanying drawings.

Amendments to the claims have been filed as follows

1. A telephone having two or more antennae, each for receiving and/or transmitting electromagnetic signals, and switch means operable to select an antenna or antennae combination to provide non-omnidirectional transmission to reduce radiation towards the user's head.

2. A telephone as claimed in claim 1, including at least one micro strip patch antenna as a non-omnidirectional antenna.

3. A telephone as claimed in any preceding claim including an omnidirectional antenna.

4. A telephone as claimed in any preceding claim in which the switch means is manually operable.

5. A telephone as claimed in any of claims 1 to 5 in which the switch means includes a proximity sensor for detecting the proximity of a human head.

6. A telephone substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

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Claims searched: 1 to 8 **Date of search:** 16 September 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4L (LECX)

Int Cl (Ed.6): H04B (1/034, 1/38)
H04Q (7/32)

Other: On-Line - WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2 277 649 A	(Motorola) See abstract	1
X	GB 2 255 460 A	(Shaye) See abstract	1,6
A	WO 95/02284 A1	(Ericsson) See abstract	-
Y	JP 8 265 026 A	(Casio) See WPI Abstract Accession No.96-511617/199651	4
X,Y	JP 5 327 612 A	(Sharp) See WPI Abstract Accession No.94-020748/199403	X: 1-3,5 Y: 4

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.